PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of:	Attorney Docket No.: 3425.05US02
Vetter	Confirmation No.: 7868
Application No.: 10/790,667	Examiner: Fenstermacher
Filed: March 1, 2004	Group Art Unit: 3682
For: OPERATOR ASSEMBLY	

DECLARATION OF BRADLEY J. THORSON UNDER 37 C.F.R. § 1.132

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

1. This declaration is made based on my own personal knowledge except as otherwise indicated.

2. My name is Bradley J. Thorson. I am an attorney with Patterson, Thuente, Skaar & Christensen, P.A., counsel of record for Applicant Truth Hardware Corporation.

3. Attached hereto as **Exhibit A** is a true and correct copy of a printout I made on November 19, 2007, from the website of Carnegie Mellon University at http://www.cs.cmu.edu/~rapidproto/mechanisms/chpt7.html.

4. I hereby declare that all statements made herein of my own knowledge and that all statements made on information and belief are believed to be true; and further that these statements were made with knowledge that willful false statements and the like so made are

punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on November 19, 2007

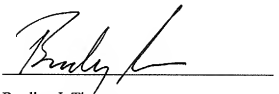

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Exhibit A

7.7 Planetary gear trains

Planetary gear trains, also referred to as **epicyclic gear trains**, are those in which one or more gears orbit about the central axis of the train. Thus, they differ from an ordinary train by having a moving axis or axes. Figure 7-8 shows a basic arrangement that is functional by itself or when used as a part of a more complex system. Gear 1 is called a **sun gear** , gear 2 is a **planet**, link H is an **arm**, or **planet carrier**.

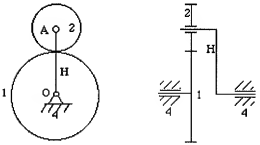

Figure 7-8 Planetary gear trains

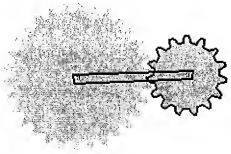

Figure 7-7 Planetary gears modeled using SimDesign

The SimDesign file is `simdesign/gear.planet.sim`. Since the sun gear (the largest gear) is fixed, the DOF of the above mechanism is one. When you pull the arm or the planet, the mechanism has a definite motion. If the sun gear isn't frozen, the relative motion is difficult to control.

7.7.1 Velocity Ratio

To determine the velocity ratio of the planetary gear trains is slightly more complex an analysis than that required for ordinary gear trains. We will follow the procedure:

1. Invert the planetary gear train mechanism by imagining the application a rotary motion with an angular velocity of ω_H to the mechanism. Let's analyse the motion before and after the inversion with Table 7-3:

	Before inversion (Original mechanism)	After inversion (Imagined mechanism)
Arm	ω_H	$\omega_H - \omega_H = 0$
Frame	0	$0 - \omega_H = -\omega_H$
Sun	ω_1	$\omega_1 - \omega_H = \omega_1^H$
Planet	ω_2	$\omega_2 - \omega_H = \omega_2^H$

Table 7-3 Inversion of planetary gear trains.

Note: ω_H is the rotary velocity of gear i in the imagined mechanism.

Notice that in the imagined mechanism, the arm *H* is stationary and functions as a frame. No axis of gear moves any more. Hence, the imagined mechanism is an ordinary gear train.

2. Apply the equation of velocity ratio of the ordinary gear trains to the imagined mechanism. We get

$$\frac{\omega_1^H}{\omega_2^H} = -\frac{N_2}{N_1}$$

(7-17)

or

$$\frac{\omega_1 - \omega_H}{\omega_2 - \omega_H} = -\frac{N_2}{N_1}$$

(7-18)

7.7.2 Example

Take the planetary gearing train in Figure 7-8 as an example. Suppose $N_1 = 36$, $N_2 = 18$, $\omega_1 = 0$, $\omega_2 = 30$. What is the value of ω_N?

With the application of the velocity ratio equation for the planetary gearing trains, we have the following equation:

$$\frac{\omega_1}{\omega_2} = \frac{\omega_1 - \omega_H}{\omega_2 - \omega_H} = -\frac{N_2}{N_1}$$

(7-19)

From the equation and the given conditions, we can get the answer: $\omega_N = 10$.